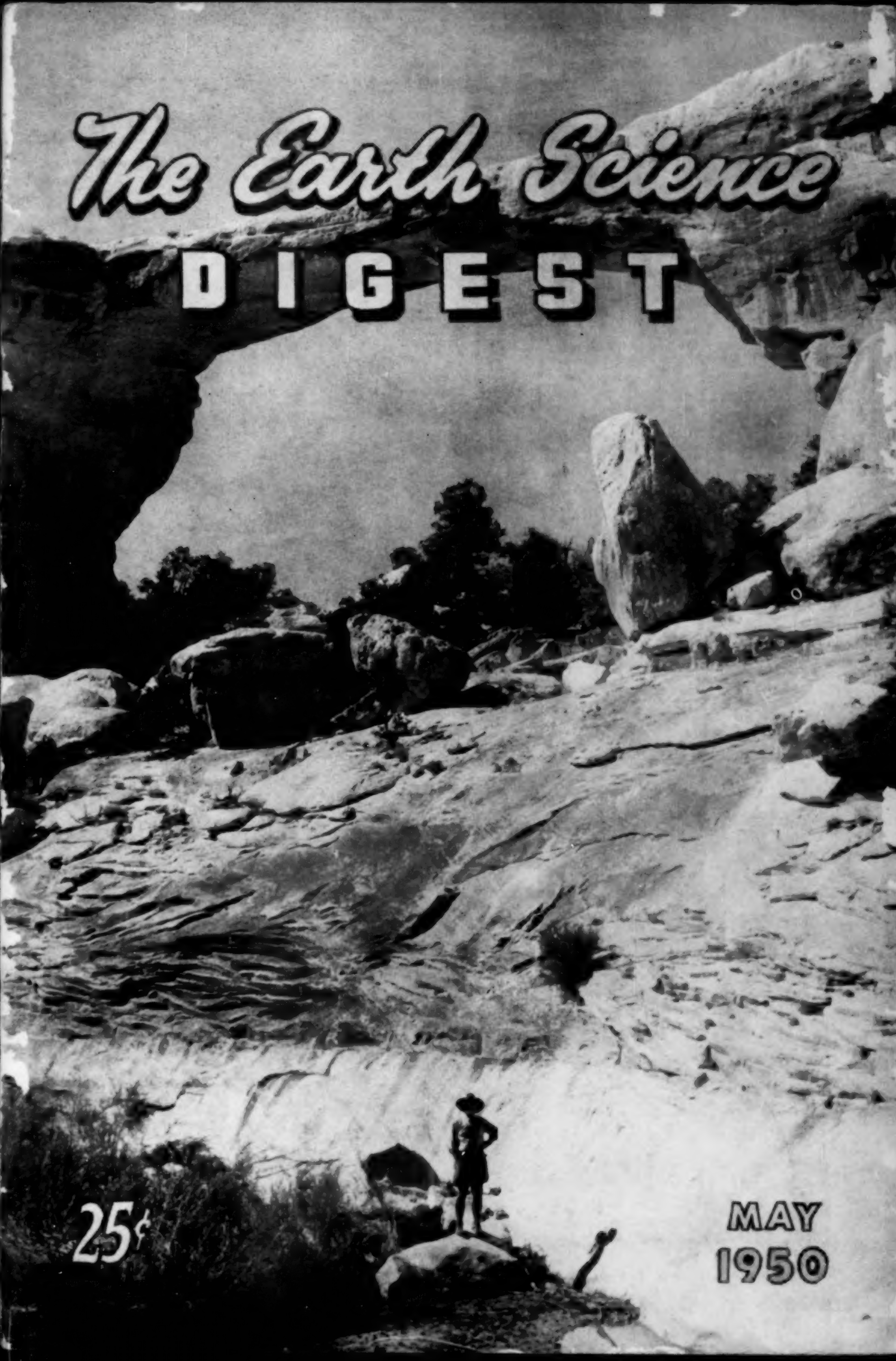
The Earth Science DIGEST



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S. ALBERT EISENBERG, Publisher
GERTRUDE ROBERTS, Business Manager

CONTENTS

ASSOCIATION OF GEOLOGY TEACHERS

The tenth annual meeting was held at the University of Illinois, April 14-15, 1950, with about 32 in attendance. The following new officers were elected for 1950-1951:

President: Paul R. Shaffer, University of Illinois; Vice-president: Rudolph Edmund, Augustana College; Sec-Treas.: Raymond C. Gutschick, University of Notre Dame; Editor: William F. Read, Lawrence College.

The 1951 meeting will be held at DePauw University, Greencastle, Indiana.

Helicopter Aids Snow Surveys In Mountains Areas

WASHINGTON, April 21 — The helicopter is replacing snowshoes as a means of transport for hydraulic engineers of the U. S. Geological Survey investigating snow conditions and flood hazards in remote mountain areas of Washington State. Air transport not only eliminates hazardous and difficult week-long trips on snowshoes but saves money and makes it possible to reach isolated areas which are otherwise inaccessible during the winter months.

Engineers from the Tacoma district office of the Geological Survey are using a helicopter in making all 1950 runoff surveys in remote areas of the Cascade and Skagit mountains. Helicopter flights in Washington State were undertaken on an experimental basis in 1947 and 1948. Although weather conditions, sometimes caused difficulties, the trials established the practicability of this mode of transport and preparations were begun last summer to make possible regular flights during winter and spring months. Instead of improving trails leading to snow courses, stocking sleeping cabins, and performing other maintenance duties, summer maintenance crews were put to work clearing landing sites and installing emergency caches. In addition, six new snow courses — inacessible by foot — were laid out.

Bad weather interferred with helicopter operations this winter, the Tacoma district office reports. On one trip, the helicopter's throttle froze and two Survey engineers were compelled to spend the night in a tent on a mountainside at 6,000 feet elevation in below-zero weather. Despite such difficulties, however, the record for snow measurements obtained by helicopter during the last two years is better than that of foot parties, the Geological Survey finds.

Meetings and Conventions

- 1950 Field Conference of Pennsylvania Geologists; Pittsburgh Geological Society. May 26-28, 1950, Pittsburgh, Pa.
- International Speleological Congress. May 27-31, 1950. Monterrey, N.L., Mexico.
- Third World Petroleum Congress. May 28-June 6. The Hague, Netherland.
- Rocky Mountain Federation of Miner-Biological Laboratory, Cold Spring June 7-9, 1950. El Paso, Texas.
- 15th Cold Spring Harbor Symposium on Quantitative Biology (The Origin & Evolution of Man). June 9-17, 1950. Biological Laboratory, Cold Spring Harbor, N. Y.
- California Federation of Mineralogical Societies, 11th Annual Convention. June 17-18, 1950. Trona, California.
- American Federation of Mineralogical Societies, 3rd Annual National Convention; Midwest Federation of Geological Societies, 9th Annual Convention, June 28-30, 1950. Milwaukee Auditorium, Milwaukee, Wisconsin.
- Wyoming Geological Association, 5th Annual Field Conference, August 9-11. Kemmerer, Wyoming.
- Northwest Federation of Mineralogical Societies, Annual Convention. Sept. 2-3, 1950. State Armory, Spokane, Wash
- Geological Association of Canada, Annual Meeting. Sept. 11, 1950. Banff, Alberta.
- National Petroleum Association, Annual Meeting. Sept. 13-15. Hotel Traymore, Atlantic City, N. J.

Cover Photo

The subject of this month's cover photo is the Edwin, or Owachomo, Bridge over a side gulch in Armstrong Canyon, Natural Bridges, National Monument, Utah.

Photo by George A. Grant, courtesy of the National Park Service.

TEACHING THE EARTH SCIENCES IN THE SECONDARY SCHOOLS

[PART ONE OF A THREE PART REPORT]

JEROME M. EISENBERG

The following report is based upon the papers and discussion presented at the Conference on the Teaching of the Earth Sciences in the Secondary Schools, sponsored by the Earth Science Institute, and held at Boston University, March 17-18, 1950. The discussion was recorded by Miss E. Louise Jewell. Both the papers and discussion have been edited and condensed in part by the Editor in order that we may present the entire report.

Part I will cover the proceedings on the Introduction, Statistics on Earth Science Education and Informal Earth Science Education.

Principal participants in Conference, March 17, 1950:

C. W. Wolfe, Chairman of the Conference, Boston University, Boston, Mass.

Robert H. Carleton, National Science Teachers Association, Washington, D. C.

David M. Delo, American Geological Institute, Washington, D. C.

Eugene H. Herrick, Boston University, Boston, Mass.

W. H. Holcombe, Brooks School, North Andover, Mass.

C. S. Hurlbut, Jr., Harvard University, Cambridge, Mass.

Florence Lovejoy, Massachusetts Audubon Society, Boston, Mass.

Arthur Montgomery, Harvard University, Cambridge, Mass.

Robert L. Nichols, Tufts College, Medford, Mass.

Gilbert O. Raasch, Illinois State Geological Survey, Urbana, Ill.

Edmund M. Spieker, Ohio State University, Columbus, Ohio.

Donald B. Stone, Mont Pleasant High School, Schenectady, N. Y.

Nancy Waterman, Children's Museum, Jamaica Plain, Mass.

INTRODUCTION TO CONFERENCE

Chairman Wolfe: We at Boston University and of the Earth Science Institute extend a cordial welcome to every one here. The Conference is admittedly an experiment. There are many people in geological circles who have thought for some time that the subject of geology is largely slighted in our secondary school education and even in our college education. Since it is slighted we feel it should have a more important part in secondary school education, and this Conference has been called with the hope that we may be able to enlist interest in earth science education at the secondary school level.

All of us who are teaching in colleges or are concerned with college work continually meet the situation where students coming into college have never heard of the subject called geology. Consequently students take geology because they don't want to take anything else or are afraid to take anything else. We feel that geology demands the highest caliber of individuals and that the only way interest can be developed in students is to start them early in finding what the earth has to offer in things of interest to them.

Our Earth Science Institute is experimental also. It is a young organization. Its purpose is to spread knowledge of and interest in geology at all levels of life, not only in schools, but to the man in the street. This purpose is shared by the American Geological Institute and many others. The Conference has sprung from a desire to see what could be done in education at the secondary school level in earth science. We do not know. Perhaps this Conference will prove that we cannot do anything to break the present hide-bound curriculum which has taken charge of so many schools. We hope we can prove that geology should enter more and more into junior and senior high school curricula.

I suppose that the primary purposes of education would be: first, to enrich living. Certainly a great deal of education has no other purpose but that we might live better; that we have an over-all picture of life which is rich and full. Certainly education is thus directed. We feel very strongly, many of us, that there is no science in junior and senior high school which would more enrich our living than knowledge of geology. Of course, there is another challenge of education and that is to prepare for the job of living; not only enrich living, but **to** live. The job of living takes on many aspects — the job of obtaining food, of obtaining materials, of obtaining raw materials for chemical industries, etc. At the background or base of all these geology has become the foundation. And so it is not with a feeling of apology but with a sort of missionary zeal that we call this Conference.

We want to make school system aware of what geology can offer. We could call it Earth Science in secondary schools. When in junior high school, youngsters are at the exploratory age. Boys and girls alike want to explore their environment, and their environment is a two-fold thing — geology and biology.

Junior high age is not only the exploratory age but it is also the pragmatic age. They want to be shown what things are and why they are. Why are the hills what they are and why are stream valleys where they are? Why are there flat plains and high mountains. Certainly the searching mind of the junior high school child is able to understand most of these things. The general science program, to which our junior high schoolers are subjected, is long on the facts of chemistry and physics, but short on the facts of geology and astronomy which would produce an understanding of that environment.

Youngsters feel, hear, and see things. Just last year I was asked to take a troop of Boy Scouts through Auburndale. I showed them glacial eskers, deposits of gravel; I showed them ancient lava rock, striated in grooves by glacial action. The boys were screaming and running about — they had tremendous energy — but they were also conscious of what they were touching, what they were seeing; and most of them were strongly interested in finding out why these things were what they are.

The world around them to junior high schoolers is very immanent. They are aware of the astronomical world and ask questions about the stars. They ask questions about where they come from, too. They live in a world of wind, air, rain, snow, sleet, temperature changes: hot and cold, etc. They should know why these things are what they are. They should be taught a little bit of meteorology . . . In short, they must understand the geological environment of which they are a part and of which they should know they are a part. Understanding the total environment will bring in the principles of chemistry and physics. It seems to me that in junior high school the students need to know **why** their environment is what it is rather than to be taught abstract facts of science without relating them to their environment.

Of all sciences, geology has the most to offer junior high students. Earth science is also the practical science for high schools, but by and large the proportion of time devoted to it in most schools is very small. To emphasize chemistry and physics as such, it would seem to me, is emphasis in the direction of a dead-end street for learning.

Around New England we have much to show students. What we show them depends upon our immediate environment. I can show my students the work of waves and currents along the seacoast, the activity of streams here and there. I cannot show them mountains but some of them eventually will get up to the White Mountains, and by that time they will have a background for appreciation. But near every school system in all New England there are special bits of geology which if given to the students will enrich their living a great deal.

One of the greatest contributions that can come out of the study of earth science in junior high schools is to make the students realize that this is a changing world. Too many people think of the everlasting hills and of topography which has never changed. Vulcanism and earthquakes are something supernatural, almost unthinkable; something which cannot be explained. Yet that is the world in which they live, and they must understand it. This Conference has been called because we believe that on junior and senior high school levels the earth sciences represent probably the most practical method of putting across the value of science to these students. Many of the students will never go to college. Some will leave high school without taking a course in science of any kind. Some are exposed to biology, some to chemistry or physics; but outside of a very few cases, they get no geology anywhere. Yet it seems to me that geology, which explains the environment of the student, is the subject he should be exposed to most. Too long we have been subjected to the tyranny of discoveries in chemistry and physics, most of which are far removed from human experience.

In every school system in this country I believe there should be opportunity for students to obtain a knowledge of the world around them. Chemistry and physics will not do it. And why teach chemistry and physics if they are going to college? I hate to say it, but practically every college department I know of takes it for granted that almost anything learned in high school is worthless, and one should take the course over again with a college professor who has an aura of greatness around him. Time spent on these sciences in high school is often wasted: the student probably has to take them all over again if he goes to college. I know in planning of our curriculum at Boston University it was planned to give students a scientific training by giving them a course in biology, and a course in general science — more or less, the physical sciences. In practically most high schools, if any science is taught, biology is offered. Yet the student goes to college, and if he wants to get out of taking the exact sciences as much as possible, he takes biology which he has already had and which therefore contributes little to his continued development, and then takes a course in physical science. It seems to me that from both the practical and cultural point of view the more earth science we teach in high schools the better off our educational system would be.

STATISTICS ON EARTH SCIENCE EDUCATION

Chairman Wolfe: I want to discuss for a few minutes the status of earth science education in our school system today. For this purpose we have a summary statement, prepared by Dr. Philip G. Johnson, which I have copied on this blackboard. First let me read you Dr. Johnson's letter:

Dear Professor Wolfe:

. . . I regret that our depleted funds for travel make it impossible for me to participate in your conference in person. I do, however, want to indicate the kinds of information which we have, in case it may be useful to you and others who gather at your conference.

Since 1895 there have been periodic studies of offerings and registrations in public high schools. There has been no separate category on the earth sciences, but from 1895 to 1934 astronomy, geology, and physical geography have been included, along with general science, which first appeared in the 1922 tabulation. It should be understood that since 1910

OFFERINGS AND ENROLLMENTS IN THE EARTH SCIENCES

	Physical Geography		Geology	
Year	Enrollment	% of School Enrollment	Enrollment	% of School Enrollment
1895	83,642	23.89	17,488	5.70
1900	121,335	23.37	18,743	3.61
1905	146,275	21.52	15,914	2.34
1910	142,948	19.34	8,538	1.16
1915	169,911	14.58	5,558	.48
1922	92,146	4.28	3,520	.16
1928	76,759	2.65	2,548	.09
1934	71,395	1.59	4,681	.10
1948	—	—	—	—

	Astronomy		General Science	
Year	Enrollment	% of School Enrollment	Enrollment	% of School Enrollment
1895	16,770	4.79		
1900	14,435	2.78		
1905	8,307	1.22		
1910	3,915	.53		
1915	3,224	.28		
1922	1,474	.07	393,885	18.27
1928	1,632	.06	507,026	17.50
1934	2,483	.06	798,227	17.75
1948	—	—	—	—

the summaries are based upon the schools that reported, rather than upon complete reports from all the schools. About three-quarters of the schools have reported since that time, and these are judged to be fairly representative of all the schools. Certainly the majority of high school students were in the schools that reported. A study for the years 1948 to 1949 is now in the process of tabulation, and summaries should be available in about a year. In the current study we are including earth science and tabulating under this heading several of the earth sciences that have previously been reported separately.

The offerings and enrollments in the earth sciences which have been summarized over the years are given on the enclosed sheet.

In interpreting the significance of these statistics, it is quite important that you give thought to the rise of general science, because a substantial portion of general science courses is devoted to the physical sciences such as geology, astronomy, meteorology, climatology and the like. This means that the great majority of junior high school level pupils come in contact with several aspects of the earth sciences. Beyond this, few students have an opportunity to study the earth sciences in high school except as such materials are related to biology, chemistry, physics, economic geography and the like. However, some schools do offer earth science, geology, and astronomy courses as such, and a few schools include courses with such titles as Industrial Materials and Processes, Coal Mining, Gold Assaying, and Agronomy. Earth Science, as a course, is offered in a number of high schools in New York State . . .

I agree with you that the earth sciences offer many opportunities for a vital type of science course and one which might have great meaning to high school students. The implementation of earth science at high school levels might reach the greatest number of students if careful attempts are made to enrich and vitalize the earth science materials which are included in general science. If this preliminary study of earth science is meaningful to the students, then the growth of separate earth science courses at the senior high school level would be more likely to be encouraged.

Quite a large number of high school leaders have reached the conclusion that physics and chemistry are not as significant to senior high school students as some other type of science offering. This is shown by the fact that many schools are experimenting with various types of alternates to physics and chemistry. Such courses as Applied Science, Advanced General Science, Consumer Science, Physical Science, Practical Science, Senior Science, Photography, Aviation Science and Earth Science are being tried. This development toward science for general education at the senior high school level is actively being explored, and there is an opportunity for leaders in the earth sciences to bring the possibilities of their area to the attention of secondary school people.

I am glad to note that the earth science leaders recognize the need for the cooperative study of the situation and for the encouragement of greater attention to the earth sciences. We in this office will be interested to know what suggestions come out of your conference and to be informed of how we may be of further assistance.

Sincerely yours,
PHILIP G. JOHNSON
Specialist for Science
Division of Elementary and
Secondary Schools
Office of Education
Federal Security Agency
Washington 25, D. C.

Chairman Wolfe: Some of you here might give us some idea of what is being given in high school systems today.

Dr. Delo: I was in Pittsburgh in early December and discussed these matters with the president of the Geological Society, who said that not one course in a single high school in the whole area but one course in physical geography was offered. This in a region which is more dependent than any other on geological resources.

Dr. Nichols: How do you account for the decrease in teaching geology in public schools?

Dr. Delo: Partly because of the marvelous advertising that chemistry and physics get — and their gadgets. High school pupils like to play with them; gadgets appeal to people; and geologists have not had gadgets. This is part of it and part is the fault of the geological profession, which has not generally bothered with advertising. While essential to industrial systems, geology has indirect rather than direct effect; and the public does not realize its importance in the background of physical and chemical advances. Physics and chemistry have direct effect on things the public uses and knows about. Geology is obscure because people cannot see through the smoke and smokestack back to the value of the material geology provides the physicist and chemist to work with.

Q. Is it not true that very few colleges admit students who have presented geology as a subject for entrance?

A. In our junior and senior high school course in geology and physics one-half of the year is geography. In 15 years we have had no college question this credit with the exception of one college whose name is known to you!

Dr. Carleton: I do hope that from the beginning in our thinking about the rile of earth science and its place in curricula for secondary schools, that we consider its usefulness to people in general and that we place college entrance requirements far down the list of criteria. About four years ago I had

Among those attending the Conference on the Teaching of the Earth Sciences in the Secondary Schools were (left to right): Henry R. Aldrich, C. W. Wolfe, Arthur Montgomery, Hugh Templeton, Robert H. Carleton, Donald B. Stone, John G. Read, John S. Barss, Edmund M. Spieker, and Jerome M. Eisenberg. This photo was taken by H. P. Zuidema on a windy afternoon in front of the Boston University College of Liberal Arts. Last month's cover photo of the Conferenece field trip to Squantum, Mass., was also taken by Mr. Zuidema.

occasion to question college's attitude toward generalized physical science — a course developed in a New Jersey high school sending 60% of its graduates to college. For some time my thesis had been that for most of the students this was potentially the most functional course we offered. But there arose the question, "Is such a course occeptable for college entrance credit?" I checked with 95 colleges and universities all over the country, I had 78 replies and every one of them said that the course would be acceptable, assuming that the secondary school was willing to recommend the student as able to do college work. In the words of one college admissions officer, "What the students **do** with what they take is much more important then **what** they take."

Dr. Nichols: Geology is not only a laboratory science but also a field science, and without field experience geology is lost. As our junior and senior high schools are set up there is no time to take students on field trips. Moreover, if an enthusiastic teacher in a high school wants to take field trips on Saturday afternoons he would have to compete with other things.

You can separate the wolves from the sheep very nicely in the field. Some are not interested in hiking or climbing, and some people cannot do field work, but you can tell who is going to be a good geologist very quickly.

Chairman Wolfe: We don't want to assume that you want to produce good geology students from this course. Students are bound to be exposed to science, so let us expose them to the things that will do them the most good; and geology is one of those things.

Mr. Stone: We have at present eight classes in earth science and the enrollment is greater than for any other science in a high school of 500 students in grades 10, 11, and 12. We have five classes in biology, five in chemistry and in physics. We have had as many as fourteen classes in earth science: our school population has greatly dropped from what it used to be — from about 2200 to around 1300. I mention this as a means of encouragement to any of you here, that in some places at least earth sciences is taught. In New York state enrollment in earth sciences has increased four-fold in the last four years. To make sure we are talking about the same thing — earth science to us means what used to be called physical geography, and I naturally assume some astronomy and meteorology.

As to field trips: I have had my experience with these over the years and have reduced it to one trip a year, because many of the students go more for a picnic and a lark rather than to take any interest in the pegmatites or whatever we are looking at. I am inclined to think that as far as field trips are concerned, unless it is a small group and the locality is especially rich in geological interest, one trip a year would suffice. In a city of some size I think it would be much better to take a few selected students who are primarily interested on a Saturday trip. They are the ones who will get something out of it.

To go back to the first point, our main interest in the problem . . . There is more need for proper training for those people who are going to give work in earth science, well integrated into a general science course or as a subject in high school. In New York most schools do not have earth science because they can't find people to teach it. In my experience of seventeen years I have known of earth science in one school where four different teachers did the work and their majors had been in chemistry, physics and mathematics. In New York everybody takes the examination for teaching certification at the same time. We are trying to have teacher-training schools put in a general earth science course to prepare high school science teachers along with courses in physics, chemistry and biology.

Dr. Nichols: Two points: why has there been a four-fold increase in teaching earth science in New York, and why has Mr. Stone been so successful in his work at Schenectady?

Mr. Stone: For one thing, since the war, many of our returning service men had been playing with meteorology, and some geology. Also, I keep a good record of our science teachers and I find that our teachers now are showing that they have had earth science courses along the way in some training school. Usually when they find there is a possibility of inaugurating a course they do what they can. That is one reason at least. Secondly, earth science was there when I went there. Perhaps I have enlarged the enrollment, but I must say that if teachers have the ability to teach there will be no difficulty in getting students, and that is a large part of it. Earth science, or geology, is one of the most interesting and fascinating of all subjects. You run into it all over — wherever you are. It is there and the children are interested in it and ask questions about it. Time after time students come back to me from the war or otherwise and they tell me that "it was the most interesting subject I had in high school; I got the most out of it."

Chairman Wolfe: This year there is an excess of geology major graduates. Practically every college in the land has a good-sized geology department. Many of these graduates cannot find anything to do with their geology major. Many want an opportunity to teach, but they do not have the requisite courses in education.

[In the absence of Dr. Raasch, the following paper was read by Mr. Eugene H. Herrick.]

EARTH HISTORY FIELD TRIPS IN THE SECONDARY SCHOOLS

by GILBERT O. RAASCH
Illinois State Geological Survey

For the student of history, the ultimate source may be the archives where the original documents are stored — but in geology, we have only to return to the earth in our immediate vicinity anywhere to find contact with the well springs of the science. If there is any one idea, above all others, that geological field trips for high school science and agriculture teachers should convey, it is this concept of the universality of geology in its "pure, natural state."

Here is a teaching aid, free and enduring, available at no more than a bus-ride's distance from every secondary school in America. As the teaching of Earth Science, in one form or another, annually assumes a greater prominence in the primary and secondary school curricula, why then is this providentally endowed teaching resource not more extensively used?

One reason has already been indicated. A majority of the teachers are not consciously aware of the potentialities of their immediately surrounding area. Even many of those with some degree of professional training in geology tend to think of geologic phenomena as of sporadic distribution, a feature of our national parks or of salient geographic areas, the gorges of the Mississippi or the Hudson, the High Sierras or the Great Smokies, Niagara or Carlsbad, the Mesabi or Franklin Furnace. The very homeliness of geology, whereby it surrounds and touches the daily lives of all of us, is the most fundamental lesson to be derived from the study of geology at the pre-college level; and it seems to me it is the lesson most neglected.

This lesson must be taught the teachers so they in turn may carry it to the students. This is a primary function of educational extension activity. But it is only the beginning. The very realization on the part of the teaching body that teaching material exists through the medium of the geological terrain in their local areas creates another problem, that of interpretation. It is far easier, from the published literature, to derive an understanding of the geology of North America than it is to obtain a comprehensive picture of the area immediately surrounding Gopher Prairie or Middletown.

This then is the second major function of Earth History Field Conferences; that is, through personal field contact and competent guidance, to give the teacher the intimate picture of the geology of the local area within which his or her school district lies. In over ninety per-cent of cases, this is the **only** way that such information can be obtained.

From the standpoint of operation of the field trips, it is most important to bear in mind this second objective, toward the implementation of which the Earth History Field Conferences of the Illinois State Geological Survey have been increasingly oriented. Since, in view of regional differences, it is impossible to generalize completely as to methods and standards of conducting a trip of this kind, the writer will necessarily confine himself to a discussion of the trips as conducted in the state of Illinois.

PARTICIPANTS

Six Earth History Field Conferences are scheduled annually, and so distributed that one is held each year in each of the six districts into which the state has been roughly divided for this purpose. Besides the teachers of high school science, anyone with a sincere interest in earth science is welcomed on the trips. Among teachers themselves, these range from primary teachers, through the high school science and agriculture departments to representatives of the smaller colleges and teachers colleges. These latter commonly use the Survey Conference as a departmental field trip and bring their students. Since many of these latter are potential science teachers, this is a development in line with the fundamental objectives of the service. Pre-college student bodies, on the other hand, are not encouraged to attend, but individual pupils with a particular interest in geology are. This commonly results in a traditional "8 to 80" age range among the participants.

The participants supply their own transportation which assembles at the rendezvous point at the appointed hour. No fees are involved and no advance registration. Registration by means of printed cards is conducted at convenient times during the course of the trip for the purpose of reporting attendance figures and also to constitute a mailing list for future announcements of trips.

The rendezvous point is the most conveniently located high school, which acts as "host." The responsibilities of the host school are not onerous, involving mainly parking area for the assembly, the use of the school's comfort facilities, shelter in case of bad weather, and, if convenient, assembly space for a pre-trip orientation talk.

THE ROUTE

A state police escort is requested for all trips. This not only provides a safety factor, absolutely essential in many congested urban areas, but also mitigates the load of responsibility in case of accidents. A consideration of traffic problems in the planning of the trip can also do much to reduce the accident factor. Each driver or his associate is supplied with a topographic map, or suitable alternative map, on which the conference route is traced. In addition, a mimeographed sheet of instruction as to safety and the procedure of driving in convoy is clipped to each route map. It has been our experience that convoy discipline has been adequate both for safety and smoothness in the operation of the trip.

An atmosphere of regimentation is avoided as much as possible and schedules are operated with considerable flexibility. Time at stops is, within reasonable limits, adjusted to "audience reaction" and less vital scheduled stops are freely omitted if the time factor seems to require it. In other cases, full stops may be converted to "rolling stops" to save time.

Participants bring picnic lunches which are eaten out-of-doors. It is essential to schedule the noon stop where a water supply and comfort facilities are available. Public parks or recreation areas conveniently fill these requirements. Beyond this, our experience has been that this stop is most appreciated as a period of independent relaxation, and talks are seldom presented. The tours are planned to disband at the last stop at between 4 and 5 P. M.

Mileage of the trips runs from 25 to 60 miles for the day. A fairly straight course in a single general direction, when possible, helps the participant to maintain his geographic orientation. Similarly, if formations can be visited in stratigraphic succession, the teacher-student more readily retains his geologic orientation. Mileage on foot is held to the necessary minimum, not so much in consideration of the varied physical capabilities of the mixed assemblage, as a measure for saving time. Walks of several miles to a remote locality through negative terrain consume precious time and energy, which must be evaluated against the importance of the stop.

COVERAGE

In the course of a single day along a 25 to 60 mile route obviously more will be encountered than can be fully treated in so short a time. (Axiomatically, the more elementary the group, the longer will be the required explanation, whether oral or written.) The geology of an area generally falls within several broad categories, to which appropriate periods of time can thus be allocated. In much of Illinois, this tends to divide into bed-rock and glacial geology. It is commonly feasible to devote the morning to the drift and the afternoon to the bedrock or vice versa, and thus avoid confusing the novice with a melange of information on geologic deposits separated by so wide a time-span as that between Paleozoic and the Pleistocene.

Physiography, of course, is always with us, as is structure. It is helpful to mount a high point at least once each trip and present a panoramic summary of the various elements that have been given more specific attention at individual stops.

Nearly everybody likes to collect, and to some this is the primary objective of their coming. This healthy desire is entitled to recognition and encouragement. If there is a locality with collector appeal so strong that the collectors will be unhappy at having the stop too short and the non-collectors will be bored at having the stop too long, this dilemma can sometimes be avoided by placing the stop at the end of the itinerary, permitting each individual to tarry to the length of his heart's desire.

In Illinois paleontology and fossil collecting is generally a function of the Paleozoic bed-rock, whereas mineralogy and lithology have a wider scope in connection with the glacial deposits, which latter have assembled nearly the full gamut of igneous and metamorphic rocks from immense areas to our north. It is of course one of the major objectives of each conference to include localities where paleontology and lithology may thus be presented.

Details of stratigraphy are seldom of great interest to the majority of the party. Unconformities representing time gaps of historical importance may be stressed, but lesser contacts and finer elements of stratigraphic and paleontologic terminology are boring and confusing to the majority. But, it is important to be ready to supply more specific information if requested by one or more of the group.

Never imply that there is anything that is beyond the comprehension of the group. The implication should rather be, that in view of the limited time, we shall stress a study of the "woods" rather than of the "trees," **but** — if you insist, we shall be glad to supply the most detailed of information or refer you to a proper source.

Never talk down to the group. Best insurance against such a tendency is to forget yourself as an individual and assume the role of an interpreter of nature. The geology of the region, truly a thrilling story always, is speaking through the medium of your presence. It is your experience and concentration on this particular aspect of natural science, not innate intellectual superiority, which has qualified and privileged you to act in this capacity. Nor is there, on the other hand, any need to dramatize the events of the geologic past. When faithfully and realistically presented, their inherent drama requires no petty human embroidery.

PREPARATION

So much for the trip itself, involving some seven to eight hours. The Illinois Survey's trips are scheduled at two week intervals, because essentially this much time is required for preparation. Scouting of the terrain and preparation of the itinerary requires from one to four days. The less spectacular the region the greater time will generally be required to uncover the essential elements for an adequate conference.

Advance reading reveals a set of potential exposures, but in our region these may show a mortality of more than 50% within a relatively few years and fine new exposures may have developed at other points in the interim. The individual localities must be located, inspected, and interpreted, and, if private property is involved, permission for a visit by the group must be secured. Respect for the private property rights of our citizens is but one more function of good public relations, and moreover is insurance against severe embarrassment on the occasion of the trip.

The weaving of the selected spots into a proper sequential itinerary, including a centrally located lunch and comfort stop often calls for considerable ingenuity in planning. The adequacy of parking space at the stops must be considered, as well as the possible effects of bad weather on roads, creeks, bridges, etc. Because both man and nature can change the aspects of our landscape very rapidly, it is advisable not to scout the trip farther in advance than a few weeks. Even then be ready with alternative routes and detours in the event of washouts, road repairs or other unforseen developments.

GUIDE LEAFLETS

The work of preparing the Field Conference Guide Leaflets follows hard on the heels of the scouting of the trip. Increasing effort has gone into guidebook preparation in recent years. This is justified by the fact that the mimeographed guide leaflets become an "extra dividend," useful subsequently to be sent upon request for local details of geology. To date, twenty areas of the State are thus covered by popular but fairly detailed descriptions of the geology. It is estimated that, on this scale, 100 such area studies will about cover the state, and a series of permanent publications may eventuate.

For the trip itself, the knowledge of the participant that he has available something to bring home that will permit him to review at leisure the geological facts of the trip contributes to his relaxation and enjoyment. He can observe and enjoy without the strain of trying to memorize and take notes. Included charts and diagrams, which can be referred to by the speaker at individual stops, expedite his talks and make for increased clarity of exposition.

The most recent guide leaflets are ten to fifteen pages in length, mimeographed, and divided into two major sections, "Itinerary" and "Geologic History." The "Itinerary" is just that, with fairly detailed description of the geology at the individual stops. The stops deserve this degree of attention as the "source documents" on which the broader conclusions set forth in the "Geologic History" are based.

In addition several charts and diagrams are apended. There is always a geologic column relating the formations of the local area to the general time scale. The geological time scale is to our science what the multiplication table is to arithmetic, and no amount of innate intelligence can substitute for the ignorance of either. Perhaps someday we may look forward to the memorizing of the time scale as a general precollege educational requirement. When it comes to fossils, the same problem presents itself with respect to the classes and phyla of the animal kingdom. A single plate is being planned which will illustrate the nature of a foram, corals, a crinoid, bryozoan, brachiopod, etc. A chart of the physiographic divisions of Illinois is added in all cases, and in appropriate areas also a moraine map and a chart showing a typical coal cyclothem. All of the above are prefabricated and simply added from stock. Many areas also require one or more specially prepared diagrams or cross-sections to illustrate structural relations, prominent nonconformities, logs of deep wells, or physiographic details.

As to language, the technical term is replaced by the popular wherever possible and the habitual cliche's of professional parlance are avoided. (In popular work one comes to realize how much ignorance can be concealed behind high-sounding professional terminology). On the other hand, it is the function of popular extension to teach vocabulary as well as facts and concepts. Some terms have no handy popular equivalent, notably stalactite, unconformity, igneous, metamorphic, moraine, kame, esker, and so forth. These have to be explained in the process of use. Other terms that it is desirable to have added to the vocabulary as part of the minimum of geologic education can be introduced by juxtaposition, such as "Pleistocene — Ice Age," "Pennsylvanian coal bearing formations" or "Pennsylvanian ('Coal Period')," "severe disturbances of the earth's crust (diastrophism)," etc.

PUBLICITY

The advance advertising of a field trip is fundamental to its success. Each year the Illinois Survey prints thousands of announcement cards, 4"x9" in size, and brightly colored so as to be readily located in file or in-basket. These cards present a resume of the date, place and salient points of interest of the Field Trip Schedule for the coming season. These are mailed to appropriate personnel in all high schools of the State. In addition, every individual who has registered on a previous trip receives a schedule annually. Small stocks are sent to local scientific societies, amateur groups, teachers colleges, etc. Announcements are also distributed in connection with scheduled lectures to teacher groups, etc.

About a week before a forthcoming trip, announcements are sent to the local papers in the section of the State to be visited. On occasion the trip itself is covered by a representative of the local press, for the purpose of carrying a following story, a practice of distinct benefit to the program. If local persons of prominence, in addition to members of the teaching profession, can be encouraged to participate, the case of public relations is materially enhanced. Whenever it is possible to have key members of the educational, social, or political community sell your program for you, such publicity is of far greater effectiveness than the equivalent amount of effort on the part of your own institution. If you and your institution can make the geology available and the other fellow can be induced to do your "selling" for you, that is extension and public relations at its best.

These Earth History Field Trips in Illinois were initiated in the '20s by Dr. M. M. Leighton, Chief of the Survey, who had formerly been a University teacher. Later a special staff member was assigned to increase the number of trips and to broaden the Survey's extension program.

Chairman Wolfe: The problem of field trips is a serious one. The Earth Science Institute is planning to contact all the colleges in New England and have them report all their regular field trips, with detailed itineraries. These we hope to collect and publish so that any school in the neighborhood of any of these colleges will be able to take the same field trips simply by following the given directions.

Has anyone present used a public address system in the field?

Dr. Spieker: Many commercial units are not powerful enough for this purpose. Some used in New York have been successful. I have used one in the West — my voice could be heard a mile away! The loud speakers were put up in the mountains.

Chairman Wolfe: Personally, I agree with Dr. Nichols that field trips are a distinctive feature of geology. You can teach other sciences in the laboratory but to get an appreciation of the world around you, field trips are absolutely essential. But only a trained geologist is able to go out in the field and report what is there to see.

Dr. Nichols: Public address system! — anyone using it ought to stay home. I wouldn't myself take more than fifteen people.

Mr. Holcombe: From my experience I should say twelve or fifteen was a very good number to have on a field trip, particularly if they are boys. Fifteen is the most one man can handle.

Chairman Wolfe: Dr. Nichols was talking primarily about field trips for the purpose of instruction. I will admit that looking at an outcrop five feet long with forty people is not good. But in some cases some of the forty people will get something out of it, and it is better than no field trip at all.

Floor: I think that field trips with small groups is ideal where feasible. No one will dispute the fact that ten are easier to handle than forty. But there are some conditions, in high school teaching for example, which involves taking along a large group or else not giving the pupils an opportunity for field trips at all. The success of large groups depends very much on preliminary planning such as was done for the large trips in Illinois. It is helpful to have assistants on the trip, to point out things; and this is generally possible, especially in colleges; and sometimes in high schools other teachers may be available. For a large group you have a bus. A great deal can be obtained from such trips, but they call for more preparation than handling a small group.

Dr. Delo: I want to take issue with Dr. Nichols on field trips where public address systems can be used. I have been on a number of the Illinois Survey trips — they are beautifully planned and go like a clockwork. Sometimes they will have well over 100 people, mostly adults. On a trip like that the public address system is a life-saver. They usually take along enough staff members so that there are others who can answer questions, and there are usually a few geologists along familiar with the area who are renewing their acquaintance with it who are glad to help out. You can now do big trips and be pretty successful, but certainly for teaching purposes about fifteen is the maximum.

Dr. Nichols: Do you use private cars?

Dr. Delo: Yes, and the cars are marked.

Dr. Nichols: I still don't like it. I think a bus is better for a large group. You know where everybody is, you limit the possibility of accidents, and so on.

Dr. Delo: Remember it is a more closely planned proposition. On local trips the high school people don't know whether they are going to be able to go at all very much in advance. You don't know how many people you are going to have.

AN EXPERIMENT IN GEOLOGIC EDUCATION IN NEWTON ELEMENTARY SCHOOLS

By ARTHUR MONTGOMERY
Harvard University

(Mr. Montgomery described an experiment in the Newton, Mass., elementary schools. An introduction and a few of the lessons and background material supplied for teachers were read. A large map showing geological outcrops in Newton was used. This material was used in the third grade, for eight-year olds.)

Floor: What about the preparation of teachers? Do you assume they have no preparation in earth science? Please say something about student reaction: I know of one case where a girl who took a geology course on the 7th grade level said she would never take it in college. This was a case of poor instruction, but I am wondering what the average student's reaction is — the reaction of both pupils and teachers.

Mr. Montgomery: Teachers participating in the mentioned workshop showed their interest, and asked a lot of questions. That was the way we tried to line it up. If they can feel that they don't have to be asked a lot of difficult questions and if they have background material given them to pass along they are willing to do it and get quite interested themselves. Most of the teachers had no idea of geology at the beginning. The children were very much interested. There were so many questions asked me that it was impossible to answer them all.

EARTH SCIENCE EDUCATION IN THE CHILDREN'S MUSEUM

By NANCY WATERMAN
Children's Museum, Jamaica Plain, Mass.

Every year thousands of children visit The Children's Museum with their parents, as members of Scout and social agency groups or in school classes. Still others come by themselves "just to look around." Thus in our Earth Science work we have to plan for the casual visitor and the school child. School talks are given, lasting one-half to three-quarters of an hour for the first, second, and third grade child, and a full hour for the fourth grade and above. Loan boxes are circulated from the Museum Lending Department to schools and other institutions and to private group leaders whose children are unable to visit the Museum itself. Mineral clubs are formed for local children who are able to come in after school. Written games based on Museum exhibits inveigle the casual child into intense study of fossils and types of rock found in the Boston area. Talks are given to Scout and Camp Fire groups, social agencies, playgrounds, and other groups, varying in content, length, and form, with the interest, background, and age of the children. During the summer the July Jaunters, a day camp lasting six weeks to which children in the Boston area come, occasionally features a "Geology Week" in which field trips, crafts, and study of Museum mineral and rock collections add special interest for the eleven to fifteen-year-old camper.

Eight subjects have been offered in

present and past years to school classes interested in the earth and its history: The Geology of the Boston Basin, Prehistoric Life, The Story of Coal, Strategic Minerals, Erosion, Early Man, Dinosaurs and Their Times, and Volcanoes and Their History. The talks consist of slides or a film, lectures before the exhibit cases, and handling material consisting of fossils representing life in the various eras, models of prehistoric animals, and rock and mineral specimens. These are passed around from child to child, giving everyone a chance to touch and smell the object.

Available films are "The Earth's Rocky Crust", "The Wearing Away of the Land", and "The Work of Running Water" put out by the Harvard Film Foundation and distributed by Erpi Classroom Films Incorporated. We find these films excellent for use with all grades, though when younger classes are seeing them a docent may talk with the film rather than using the sound track. The ephemeral nature of land masses is emphasized with the processes of erosion described clearly, as well as the formation of sedimentary, metamorphic, and igneous rock, and the importance of fossils in determining the life, terrain, and climates of past ages. The films are discussed after presentation in order that questions in the minds of the children may be cleared up while their impressions are fresh. Important details are noted by the docent.

In our Geology Room after the film or slides, the children see different types of fossils, a colorful Geological Time Chart, and a series of charts representing the Geologic History of the Boston Basin. Large rock specimens from the vicinity serve as illustrative material; dioramas showing the early cave man with his tools and weapons and of Tyrannosaurus and Triceratops in the forest of their day always provoke excited comments. A temporary exhibit tells the story of coal, and in another the volcano is discussed. A case of gems and of bright mineral specimens tempts the casual visitor into the room.

In the last ten years, 247 school talks on these subjects were given by staff members. Twenty-nine of these were given to classes from private schools, five to colleges, and one to a high school. We find that few high schools are able to visit the Museum due to crowded curricula. Twenty-three talks on more or less the same lines are given to groups ranging from Sunday schools to playgrounds, mineral clubs, and YMCA camps. During the war, when classes were unable to come to the Museum, due to lack of transportation, staff members traveled to schools on request carrying slides and handling material with them.

During the same ten-year period loan exhibits were going out with labeled specimens and pictorial matter on two-week loans. Seven different earth science subjects are available: Geology of the Boston Basin, Minerals Found in New England, Common Minerals, Coal, Oil, Life Ages Ago, and Strategic Minerals. Samples of these loan boxes may be seen at the Museum's exhibit table at this meeting. Eighty different towns have made use of our traveling geology exhibits. Most of them have been situated near Boston, or are in Greater Boston itself. Some, however, are towns in New Hampshire, Vermont, and Rhode Island. The boxes have to date been sent out 1710 times. Elementary public school systems have used them 1140 times. They have gone to high schools 92 times, 52 times to private schools, and 35 times to colleges. Social agencies and other groups used them 544 times. Thus schools and organizations unable to finance a trip to the Museum have been able to use Museum geology material which otherwise would be gathering dust in storerooms.

Besides the school talks and the loan boxes, the children living near the Museum have had the opportunity of joining the mineral club for those in the fourth grade and above which in past years has been conducted by a member of the education department. Interests found in working in such a club may furnish the incentive for life-long hobbies, and in the case of a few to active careers connected with the earth sciences.

We are delighted over the response to our game system among school children of all ages. Every year thousands of children play these games based on the Museum exhibits. You will find examples of those on mineralogy, early man, and prehistoric life on the Museum exhibit table. These games are fun to do, and though the child is expected to get a perfect score he considers it a game rather than a test and learns while he hunts for answers in cases which he would otherwise pass with only a cursory glance. Local children who might avoid the Museum after several introductory visits, return daily or weekly in order to play the games, thus building up points in the Museum credit system which lead to coveted honorary and material awards.

Five weekly courses of one hour each are offered scout troops working on first class merit badges. Troops from Roxbury, Roslindale, Jamaica Plain, Natick and Brookline have completed work on the Rock Finder Badge, with the benefit of films, slides, lecturing, handling and exhibit material, and field trips which aid the child to connect the outer world with experience gained inside the Museum.

In the July Jaunter summer program the earth sciences have been stressed during "Geology Weeks" when children go on a day-long trip to a spot of local geological interest, work on the identification of minerals, do craft work, and create habitat groups of their own. The children in this program, sixty in number registered each week, arrive at 10 A.M. and stay until noon; then after a two-hour lunch and play period return for two hours in the afternoon. The program continues from Tuesday through Friday for six weeks of the summer. Subjects are chosen for weekly themes. There is no cost to the child other than that for transportation on a weekly all-day field trip.

Besides work with children of elementary and secondary school age, students from Leslie and Wheelock Colleges have received help on the problems of planning geology projects for the classroom.

In our monthly bulletin and through contact with P. T. A. and Conference groups and in publicity and work with embryo teachers, we continually encourage more schools and groups to visit the Museum and use the facilities I have been describing today. For those to whom a visit en masse seems impossible due to lack of transportation, loan boxes are continually renewed and new ones being assembled. However, I feel that more use should be made of the Museum exhibits. Since its inception in 1913 staff members and trustees alike have been interested in the presentation of earth science material. Large and varied collections, clearly labeled and interesting exhibits, and open countryside near by for field trips, make the Museum an excellent focal point for the study of geology. The subject is a fascinating and stimulating one for children and we look forward to a time when more and more schools, because of expanded science programs, will venture to our doors in search of the help we are willing and eager to give.

Floor: How long in advance should you reserve exhibits?

Miss Waterman: It depends on how much they are in demand—some exhibits are booked a year in advance. Geology exhibits are not so much in demand and may be obtained on about a week's notice.

Floor: How far ahead should school parties let the Museum know they are coming to visit?

Miss Waterman: In an emergency we can take care of even a large group with a few hours' notice, but it is difficult. It is better to give notice of your visit a week or so in advance, especially in the spring when we are very busy; but in the winter, groups may come any time at all.

Floor: How much work does the Museum offer in geology?

Miss Waterman: Due to the interest of the Trustees from the beginning, geology has been an important part of the Museum's program in science. A geology major who understands children is usually chosen for the work. Our astronomy program is excellent also. We offer quite a lot of geology even for very young children.

[Part II of this report will appear in the June 1950 EARTH SCIENCE DIGEST.]

AEROMAGNETIC SURVEY REVEALS MINNESOTA IRON FORMATION

MINNEAPOLIS, March 31 — A potential iron formation with a magnetic pattern remarkably like that of the Mesabi iron range lies buried beneath the glacial drift in a wide belt extending some 30 miles across the northwest corner of Itasca county in north central Minnesota.

This was revealed today with the public release by the U. S. Geological Survey of 21 additional maps based on the aeromagnetic survey of 30,000 square miles of northern Minnesota underway since 1947 as a joint project of the federal bureau and the Minnesota Geological Survey.

The purpose of the aerial survey, according to Dr. G. M. Schwartz, director of the Minnesota Geological Survey and University of Minnesota geology professor, is to determine the major magnetic trends associated with the known deposits of iron ore in the state, to ascertain possible extensions of those deposits and to indicate new areas which may be favorable for further exploration.

Under the latter heading falls the band of abnormal magnetic attraction found in northwestern Itasca county just south of Island lake. Dr. Schwartz described this zone as "one of the most interesting new areas thus far disclosed in the survey" and recommended careful exploration to determine whether or not the indicated formation contains deposits of commercially valuable iron ores.

The state geologist pointed out, however, that in the vicinity of Funkley the west end of this belt merges with a large known granite formation which underlies much of Beltrami county. This fact raises the question as to whether this zone, which is remarkably like the Mesabi range in magnetic pattern, may be merely a granite area. Only extensive ground exploration and core drilling can determine just what lies below the glacial drift.

Thanks to the new maps a complete magnetic picture of the Mesabi range, the world's most important iron ore producing area, is now available for the first time. This picture of the Mesabi now gives geologists a valuable basis for the evaluation of unknown areas by a comparison of the magnetic characteristics of the producing iron range and those of the areas being explored by aeromagnetic survey.

Also particularly well-defined by some of the maps issued is the magnetic picture of the Cuyuna iron bearing district. The maps show that the mines, both open pit and underground, in this district are in areas of "considerable magnetic complexity". The mines are concentrated in areas where the iron formation is shown by the magnetic maps to be folded laterally into "U" shapes, and the iron deposits seem to follow the "U" shape of the formation.

Shown clearly on the maps is the southwestward extension of the Cuyuna range formation beyond the area in which mining operations are now being carried on.

"The magnetic belts of the Cuyuna range are shown crossing the Mississippi river in the vicinity of Camp Ripley and are about 15 miles in width," Dr. Schwartz stated. "West of the river, these belts swing sharply southward and then die out gradually in the vicinity of Flensburg, southwest of Little Falls in Morrison county. The reason for this southern termination of the Cuyuna range formation at this point is not well understood at present, but we do know that there are massive areas of granite just to the south."

At the other end of the Cuyuna range, the new maps show a northeastward extension of the range formation to about the center of Aitkin county. This extension of the range formation has been known to geologists for some time but the outline shown on the maps is expected to be a great aid to further study and evaluation of the zone for future mining operations.

Also shown by the aeromagnetic maps is a wide belt of abnormal magnetic attraction which runs through Itasca, Cass, Hubbard and Becker counties, parts of which were noted on maps of the survey released in 1949 and earlier this month.

Maps released earlier this month also disclosed the outlines of an 80-mile-long potential iron formation shaped like an "E" in northeastern Otter Tail and southeastern Becker counties.

The maps made public today cover 15,850 square miles of the area surveyed and bring the total area for which maps have been issued to 21,350 square miles.

Dr. Schwartz pointed out today that there are very large areas on these aeromagnetic maps which show little variation in magnetic intensity or attraction and, therefore, according to present geologic knowledge, little possibility of yielding iron ore. For the most part these large areas are underlain by slates and occur in most of the counties included in the portion of the state covered by the 27 maps now available for public examination.

In addition to their value in locating and outlining possible iron formations which may contain valuable iron ore deposits, the maps based on the aeromagnetic survey are going to be of great value in determining and understanding the geology of the state, Dr. Schwartz asserted.

Used in the survey flown over the northern part of the state during the last three years was an instrument know as the airborne magnetometer, nicknamed "doodlebug", a device which detects and records variations in the earth's magnetic field while being flown over the survey area at an altitude of 1,000 feet in paths at one-mile intervals.

Enclosed in a bomb-like container, the magnotometer's detector unit is suspended on a long cable from a specially equipped airplane operated by experts from the United States Geological Survey. The recording device is carried in the airplane. The instrument is similar to a device developed by American scientists during World War II for use in detecting submerged enemy submarines from the air.

"The necessity for aerial magnetic work arises from the problem of the thick glacial drift over much of Minnesota. Magnetic work on the ground has been carried on for a long time in the state, but the process is slow, and consequently, only selected areas have been covered. No one person or group has acess to more than a fraction of the data thus compiled," explained Dr. Schwartz.

For an interesting account of the airborne magnetometer, see "Geophysical Exploration with the Airborne Magnetometer" by Homer Jensen, in the November 1949 EARTH SCIENCE DIGEST.

FORTHCOMING ARTICLES

A Geologist Visits Europe — Both Sides of the Iron Curtain, by Horace G. Richards.

A Glossary of Mineral Species, by Jerome M. Eisenberg.

Teaching the Earth Sciences in the Secondary Schools — Organizational Work, Mechanics of Earth Science Education, Preparation of Teachers.

Prospecting for Ores by Geochemical Methods, by Jerome M. Eisenberg.

Geologist Helps Solve Problem of Decreasing Maine Clam Population

WASHINGTON, May 9 — A preliminary report by the U. S. Geological Survey on the sediments and physical environment of the Sagadahoc Bay tidal flat, Georgetown, Maine, formerly a productive source of clams, was made public today by the Department of the Interior.

The physical features and sediments of this tidal flat were investigated in the summer of 1949 by W. H. Bradley of the Geological Survey, at the suggestion of Dr. Joseph Trefethen, State Geologist of Maine, and officials of the Maine Department of Sea and Shore Fisheries.

Purpose of the investigation was to determine if changes in the rate of deposition of the sand and mud on this flat might be a contributory cause for the recent decrease in clam productivity. Biologists of the U. S. Fish and Wildlife Service and of the Maine Department of Sea and Shore Fisheries have been making intensive studies of the clam population and yields on the clam flat.

The geologic report released today indicates that the surface of the flat is gradually building up but at a rate that probably is not harmful to the clams. On the other hand, study of the buried layers of shells below the surface of the flat and the late geologic history of the flat suggest that periodic incursions of vast numbers of other organism may compete with the clams and thereby account for decreased clam yields. Further joint efforts by the geologists and biologists of these organizations are planned for the summer of 1950, to test this and other theories.

Copies of the report, which contains a detailed map of the flat, may be consulted at the Boothbay Harbor (Maine) Laboratory of the Fish and Wildlife Service; the Department of Sea and Shore Fisheries, Vickery Hill Building, Augusta, Maine; the office of the State Geologist, University of Maine, Orono, Maine, the Office of the District Engineer, U. S. Geological Survey, 927 Post Office Building, Boston, Mass; the Office of the Director, Fish and Wildlife Service, Washington, D. C.; and at the Library of the U. S. Geological Survey in Washington, D. C.

Earth Science Abstracts

[Selected articles on the earth sciences, appearing in current scientific publications, are abstracted here for the convenience of our readers.]

THE CRUST OF THE EARTH. Walter H. Bucher. **Scientific American**, Vol. 182, No. 5 (May 1950), pp. 32-41. The complexity of the crust beneath the continents is the result of major crustal folding. The shields and their continuation beneath the sedimentary platforms of the continents are eroded stumps of earlier folded mountain ranges, proving that the position of the sea level with reference to land has not changed radically since the Cambrian. Between the continental and oceanic layers, sections of the continental granitic crust have been brought down to oceanic depth by the basin-forming process. Crustal deformation, still going on actively, has produced belts or folded mountain ranges from the basaltic crust beneath the ocean floors.

GIANT QUARTZ AND TOPAZ CRYSTALS. J. Coggin Brown. **The Gemmologist**, Vol. 19, No. 224 (March 1950), pp. 49-53. Giant quartz crystals, weighing as much as 1470 pounds have been found at Sakangyi, Upper Burma. A Japanese quartz crystal has been said to measure 4′ 3½″ in length, with a diameter of 18″ and a weight of 1,518 pounds. A giant crystal over eight feet long from Sakangyi has been reported, although efforts to find it have been unsuccessful. Ten-pound topaz crystals have been found with the quartz crystals.

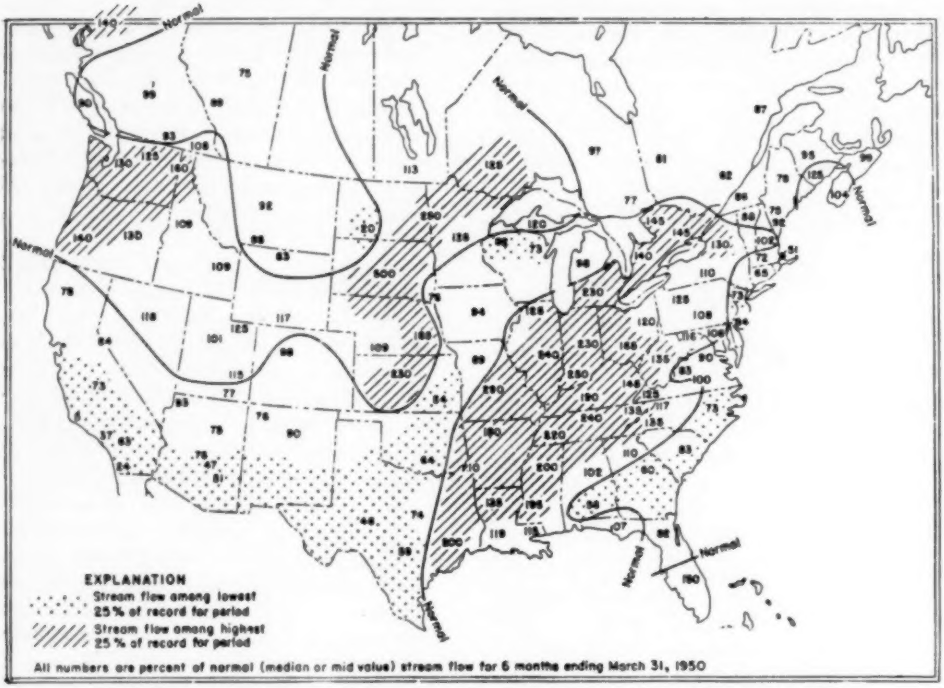
RADIATION SURVEYS WITH A SCINTILLATION COUNTER. George M. Brownell. **Economic Geology**, Vol. 45, No. 2 (March-April 1950), pp. 167-174. A portable Scintillation counter, a speedy and accurate way of measuring radiation intensities, developed in 1949, is about 100 times more sensitive than a portable Geiger counter. It can be used for making assays or radioactive samples and may be used as a spectrometer to distinguish between uranium and thorium in ores. Field methods (radiation grid surveys) are described, with an account of its first use — in making surveys over pitchblende deposits in the Lake Athabaska region, Saskatchewan, Canada.

STORM KING GRANITE AT BEAR MOUNTAIN, NEW YORK. Kurt E. Lowe. **Geol. Soc. Am. Bull.**, Vol. 61, No. 3 (March 1950), pp. 137-190. The Storm King granite occupies the core of a syncline in the earlier crystalline complex of the Hudson Highlands. Magmatic intrusion is indicated by reasonably constant mineral composition, flow structures of early hornblende crystals, and inclusions confined to the margins of the granite body. The author suggests that the active subsidence of the region into the emptying magmatic chamber made room for the intrusion, while the space previously occupied by the country rocks was filled by the concurrently rising magma. That both Precambrian and Paleozoic orogenies affected this region is suggested by the interpretation of the major thrust and normal faults.

TWINNING IN THE DIAMOND. Chester B. Slawson. **Am. Mineral.**, Vol. 35, Nos. 3-4 (March-April 1950), pp. 193-206. Twinning is a dominant characteristic of the diamond, and may be revealed by the variation in hardness with direction. Twinning on (111) should be expected as a normal deviation in the growth process. Due to its high symmetry, twinning usually occurs on more than one of the octahedral faces at the same time, giving rise to multiple twins of complex nature which have commonly been considered random intergrowths. Inclusions within the diamond are correlated with twinning. Structural conditions indicate that crystal growth proceeds not by the accretion of single atoms, but by the accretion of two or multiples of two layers of atoms.

WATER RESOURCES

6 MONTHS REVIEW



Percentage of normal stream flow for 6 months ending March 31, 1950.

The water supply in the New York and New Jersey metropolitan area was of major interest during the past 6 months. At the end of March, however, storage in New York City's reservoirs had increased to 60 percent of capacity from a low of 35 percent in December.

Ground - water supplies are generally favorable, although water levels may be expected to continue to decline in certain areas of heavy pumping, particularly if summer precipitation should be deficient.

Storage reserves for irrigation and power in the West are generally considered favorable, except in some areas of Arizona, where winter runoff was deficient. However, snow cover is below normal in southern Nevada, Utah, and Colorado, and in New Mexico and Arizona and the carryover for next year may be substantially reduced.

Flow of the Columbia River at The Dalles was far above normal during the 6-month period. The possibility of spring floods in the Pacific Northwest will depend to a large extent on precipitation and temperatures during the snowmelt season.

New Books

All books listed here are deposited in the Library of The Earth Science Institute and may be borrowed by the members. Books marked with an asterisk may be purchased through The Earth Science Publishing Co., Revere, Mass.

*GEOCHEMISTRY

Kalervo Rankama and Th. G. Sahama. 1950. xvi, 912 pp., 50 figs., $15.00. (University of Chicago Press, Chicago.) This voluminous work is an attempt to survey the broad field of geochemistry, with emphasis on the quantitative aspects and the synthesis and summarization of the new geochemical ideas and data of the past decade. This first modern account of the chemistry of the earth deals with the composition and structure of meteorites; the abundance of elements and nuclides; the geochemical structure of the earth; the geochemistry of the geospheres (lithosphere, hydrosphere, atmosphere, and biosphere) and the distribution of elements therein; cosmochemistry; the geochemical evolution of the earth; and a detailed treatment of the manner of occurrence of the elements. A bibliography contains more than 700 titles, and is followed by extensive author and subject indices. This volume is a veritable encyclopedia on the subject, and will surely takes its place among the classic works in geology.

*INTRODUCTION TO THEORETICAL IGNEOUS PETROLOGY.

Ernest E. Wahlstrom. 1950. x, 366 pp., 155 figs.; $6.00. (John Wiley & Sons, New York). This latest book by Dr. Wahlstrom stresses the quantitative aspects of theoretical igneous petrology, with a lucid discussion of the theory and practice of heterogeneous equilibrium and the phase rule, accompanied by an invaluable compilation of phase rule diagrams. Beginning students will value the introductions to the theory and practice of geophysics and physical-chemistry. Physical-chemical concepts fundamentally important to petrologists are reviewed in an appendix. The excellent diagrams will be especially appreciated by the student when he studies three- and four-component systems. With the emphasis on theoretical concepts, descriptions of actual field examples are held to a minimum.

SUMMER FIELD COURSES IN GEOLOGY — 1950

American Geological Institute. 1950. iv, 102 pp., 1 fig.; $1.00. (Report No. 1, A.G.I., 2101 Constitution Ave., Washington 25, D. C.) This report describes more than 150 courses offered by 79 colleges and universities. The descriptions include geographic location; inclusive dates; geology of the area; manner of instruction; names of faculty; nature of required reports and maps; facilities; cost; academic credits; and instructions for registration. Many of these courses are open to students with only one year of general geology; four will offer courses on elementary geology. About one-third of the centers will be co-ed.

ORIGIN OF KANSAS GREAT PLAINS DEPRESSIONS

John C. Frye. 1950. 200 pp., 4 pls., 2 figs.. $0.10. (Bull. 86, Part 1, Kansas State Geol. Survey, Lawrence.) Undrained depressions are a characteristic minor element of Kansas Great Plains topography. Several processes of origin are required to explain the many diversified features. They are classed in two general groups: (1) solution-subsidence depressions, and (2) nonsolutional features produced by variously differential eolian deposition or erosion, compaction, silt infiltration, and animal action.

Recruitment of Minerals Experts For Foreign Jobs Impeded

WASHINGTON, May 2—Reluctance of American technical experts to leave their families behind is a major obstacle to success of the program for recruiting technicians to survey mineral resources in United Kingdom dependencies in Africa, the Far East and British Guiana.

Through the Economic Cooperation Administration, the U. S. Geological Survey is seeking to aid the British government in making colonial mineral surveys by loaning men and women qualified to map remote areas, locate new mineral deposits, determine their economic value, and at the same time train British personnel to take over the work in two or three years.

The need for top-notch scientists and engineers to stimulate mining programs in British colonies is acute, Secretary Chapman said, because Britain was unable to train enough technicians during the war years. About 60 American experts are being sought under the $1,500,000 ECA-financed program.

So far, 11 U. S. and Canadian technicians have accepted positions under the minerals survey program. Three have already arrived in Africa. They are: Burton E. Ashley, geologist of Denver, Colo., whose headquarters will be in Zomba, Nyassaland; Floyd M. Ayers, geologist, Alhambra, Calif., in Nairobi, Kenya, and J. R. Welch, mining engineer, Wenatchee, Wash., in Dodoma, Tanganyika.

Soon to leave are: Robert R. Reynolds, geologist, Shullsberg, Wis., to go to Kaduna, Nigeria; Allan P. Fawley, geologist, Winnipeg, Manitoba, Can., to Dodoma, Tanganyika; Roderick Murchison, Chapel Hill, N. C., to work on fuels in Kenya; Dan K. Hamilton, minerals, Chapel Hill, N. C., to Kenya; William Eberth, mining engineer, New York, N. Y. to Tanganyika; C. E. B. Conybeare, petrologist, Winnipeg, Canada, to the Gold Coast; Walter Lewiecki, minerals, Silver City, N. M., to Tanganyika; and Fred R. Waldron, minerals, Fargo, N. D., to Uganda.

Some of the areas included in the program are virtually unstudied geologically, officials of the Geological Survey's Foreign Geology Branch point out. The following types of specialists are needed: (1) topographers who can produce base maps; (2) geologists to study the occurrence of minerals and determine geological sequence; (3) chemist assayers to determine the quality of ores; (4) petrologists to study the rocks themselves; and (5) mining engineers to plan the development and use of minerals discovered.

Positions for which technicians are being sought are as follows:

Nigeria: two geologists, P-6, experts on minerals. three geologists, P-4 or P-5 (minerals).

Gold Coast: one geologist, P-6 (minerals or general); one geologist, P-4 or P-5 (minerals or general).

Sierra Leone: one geologist, P-4 or P-5 (minerals or general).

Tanganyika: one hydrologist, P-4 or P-5.

North Borneo and Sarawak: one geologist, P-4 or P-5 (minerals or petrology); one geologist, P-4 or P-5 (fuels or paleontology).

Positions at Grade P-6 pay from $7,600 to $8,600 a year; at Grade P-5 from $6,400 to $7,400, and at Grade P-4 from $5,400 to $6,400.

THE EARTH SCIENCE INSTITUTE

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THE EARTH SCIENCE INSTITUTE BULLETIN is published occasionally by the Earth Science Institute for its members. All communications should be addressed to Jerome M. Eisenberg, Executive Secretary, The Earth Science Institute, Revere, Massachusetts.

THE SECOND ANNUAL MEETING — MARCH 17, 1950

The second annual meeting of the Institute was held at Boston University, March 17, 1950. The entire slate of officers was re-elected for 1950-51. It was voted to affiliate with the National Science Teachers Association, following an explanation of the purpose of this affiliation by the executive secretary of the Association, Dr. Robert H. Carleton.

The Earth Science Digest was adopted as the official publication of the Institute. Special publications on various phases of the earth sciences will be issued occasionally, the first two being a booklet on caves, and a catalog of mineral species. Plans are being made to publish booklets on regional field trips.

A photograph contest will be conducted this fall among students of undergraduate college level or younger.

A second Conference on the Teaching of the Earth Sciences will be held next spring, at the same time as the Annual Meeting of the Institute. This Conference will probably include sessions on both primary and secondary school work.

THE INSTITUTE LIBRARY

Over 200 new books have been loaned to the Institute by the Executive Secretary bringing the total number of books in the Institute Library to well over 350. Contributions of publications for the Institute Library will be gratefully acknowledged. We will not list the new additions for lack of space, but we might now state that the list covers nearly all the important books on the earth sciences published during the past century, and is especially rich in books on mineralogy and general geology. These books are available for the use of all Institute members, and may be sent by mail or called for at the office of the Executive Secretary. For library rules, see the August 1949 Institute Bulletin.

CONFERENCE ON THE TEACHING OF THE EARTH SCIENCES IN THE SECONDARY SCHOOLS

The first part of the Conference report is published in this issue of the Earth Science Digest. See pp. 3-18. The second and third parts will be published in the June and July 1950 **Earth Science Digests.**

Over 100 persons attended the two-day Conference, up to 85 attending individual sessions. Although registration was not compulsory, the majority registered to receive the Conference reports. This was our only record of those attending. They represented the following schools and organizations:

COLLEGES: Boston University (College of Liberal Arts and School of Education), Dartmouth College, Harvard University, Ohio State University, Springfield College, Tufts College, University of Massachusetts, University of Michigan.

SECONDARY SCHOOLS: **Massachusetts:** Amesbury H. S., Amherst H. S., Belmont Hill School (Belmont), Beverly Jr. H. S., Brookline H. S., Brooks School (North Andover), Coolidge Jr. H. S. (Natick), Foxboro H. S., Franklin H. S., Lexington H. S., Marblehead H. S., Phillips Academy (Andover), Quincy H. S., Salem H. S., Saugus H. S., Shrewsbury H. S., Wm. Howard Taft School (Brighton).

New Hampshire: St. Paul's School (Concord), Troy H. S., W. Lebanon H. S.

Connecticut: Meriden H. S., Simsbury H. S.

Rhode Island: Lincoln H. S. (Prov.).

New York: Mont Pleasant H. S. (Shenectady).

ORGANIZATIONS: American Geological Institute, Children's Museum (Jamaica Plain, Mass.), Earth Science Institute, Geological Society of America, Mass. Audubon Society, National Science Teachers Association, New York State Education Department.

D. C. Heath & Co., D. Van Nostrand Co., Ward's Natural Science Establishment, John Wiley & Sons.

12 exhibits of publications, teaching aids, collections, etc., were presented.

Rain of Meteors Best Explanation For Carolina Craters

WASHINGTON, May 4 (Science Service) — After 17 years, geologists are still arguing the mysterious case of the Carolina "bays." They are just as stumped as airline passengers who see the miles of shallow, crater-like depressions in the coastal plain of North and South Carolina.

A spectacular shower of meteorites bombarding the continent in prehistoric times is the best theory offered so far, Dr. William Schriever of the University of Oklahoma told the annual meeting of the American Geophysical Union here. It probably happened while the Carolinas where still under the Atlantic Ocean, he said.

Dr. Schriever denounced as "untenable" the theory of a complex chain of events, started by great, bubbling prehistoric artesian springs, which Columbia University's late, top-ranking geologist, Prof. Douglas Johnson, outlined in an authoritative book in 1942.

Using Prof. Johnson's own requirements for an adequate theory, Dr. Schriever said the idea of meteorites, first advanced by himself in 1933, is still the "least unsatisfactory."

The missiles from space could have struck the coastal plain while it was still under the shallow sea, he said. Centuries of waves would have filled the craters with sediment. Then, when the plain rose above water, the loose fill in the craters could have settled like earth in an improperly-made grave.

To learn whether great ironstone meteorites are actually buried there, and before a completely satisfactory theory can be presented, subsurface investigations must be made, Dr. Schriever said. Such tests will be helped not at all by the fact that most of Carolina's mystery holes are now lakes or tangled, soggy swamps.

The BOOK SHELF

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OUR TEN "BEST SELLERS"

Since we began to advertise our complete catalog of books on the earth sciences, which appeared in the Earth Science Digest from June 1949 to January 1950, we have found the following ten books to be the ones most in demand by our readers from the list of over 250 titles:

1. THIS EARTH OF OURS by C. W. Wolfe. 1950. 384 pp., illus. .... $ 5.00
2. HANDBOOK OF URANIUM MINERALS by Jack DeMent and H. C. Dake, 2nd Edition, 1948. 96 pp., 22 illus. 2.00
3. MANUAL OF MINERALOGY by Edward S. Dana. 15th Edition revised by C. S. Hurlbut, Jr. 1941. 480 pp., 436 illus. 4.50
4. GETTING ACQUAINTED WITH MINERALS by George L. English. 1936. 324 pp., 258 illus. 2.75
5. TEXTBOOK OF MINERALOGY by Edward S. Dana. 4th Edition revised by William E. Ford. 1932. 851 pp., 1089 illus. 6.00
6. HISTORICAL GEOLOGY by Carl O. Dunbar. 1949. 567 pp., 380 illus. 5.00
7. OPTICAL CRYSTALLOGRAPHY by Ernest E. Wahlstrom. 1943. 260 pp., 208 illus. 3.25
8. DANA'S SYSTEM OF MINERALOGY. 7th Edition by Charles Palache, Harry Berman, and Clifford Frondel. Vol. I: Elements, Sulfides, Sulfosalts, Oxides. 1944. 834 pp., 1500 illus. 10.00
9. INDEX FOSSILS OF NORTH AMERICA by Hervey W. Shimer and Robert R. Shrock. 1944. 837 pp., 303 pls. 20.00
10. THE OCEAN by F. D. Ommaney. 1949. 238 pp., 16 illus. 2.00

Is there a book relating to the earth sciences which you need and which was not listed in our catalog? If so, why not write to us? We can obtain for you practically any "in-print" book published.

The Book Shelf

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